



U.S. DEPARTMENT OF
ENERGY

Legacy
Management

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Unmanned LiDAR for Legacy Management

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Track 2: Advancing science and technology to reduce costs while maintaining
or improving protection of human health and the environment

Agenda

- Juniper Unmanned Commercial UAS background
- LiDAR technology development
- UAS LiDAR capabilities and limitations
- LiDAR products
- Tuba City Disposal Site project
- Change Detection
- UAS LiDAR benefits to Legacy Management
- UAS Magnetometry



Juniper's Evolution

Past

- UAS training organization for Trimble and Topcon
 - Flight safety and FAA compliance
 - Optimal data collection

Present

- Data acquisition
 - A leading UAS LiDAR provider
 - Data processing
 - Insights
 - Solutions

Future Capabilities

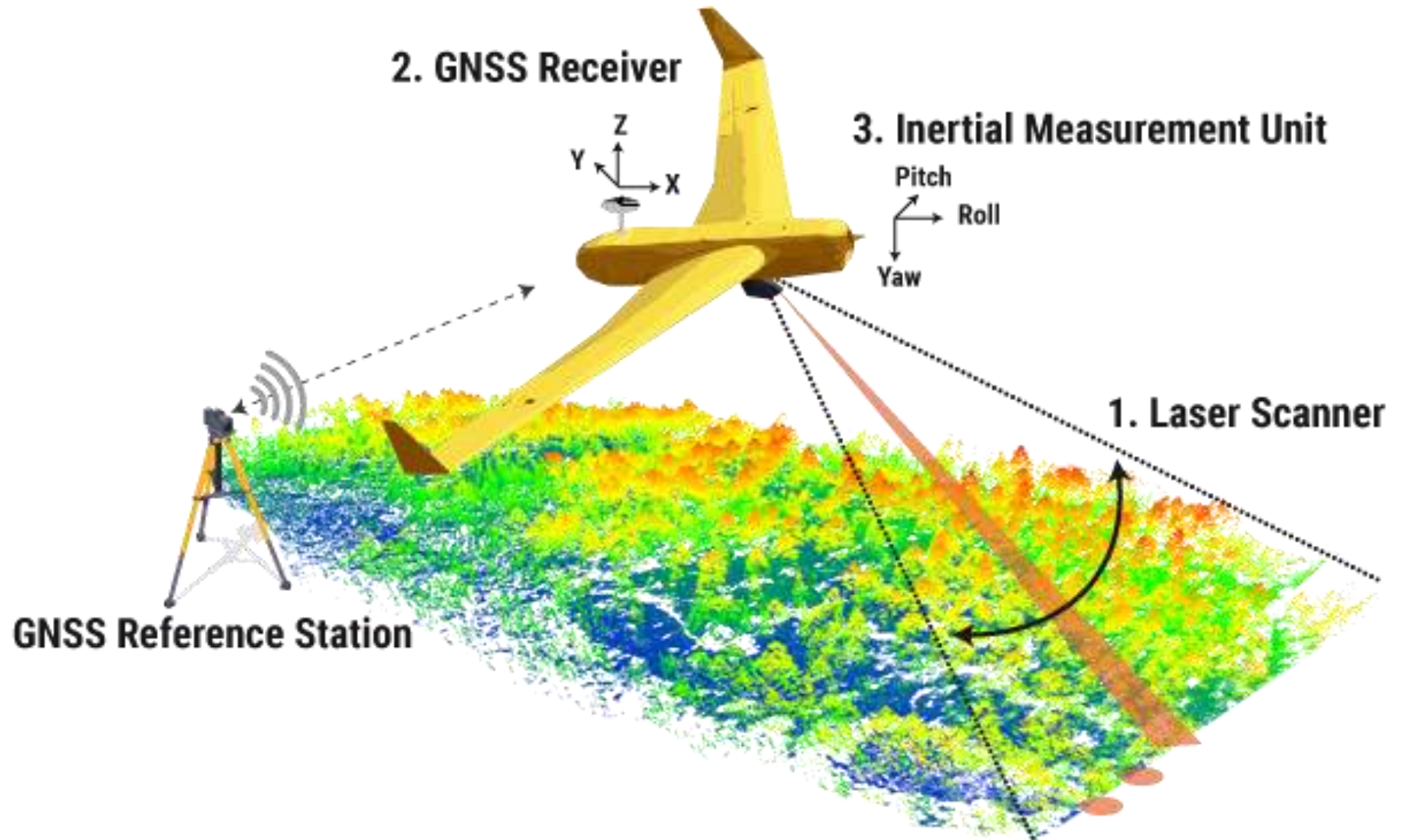
- Data analytics and management
 - Predictive and prescriptive analytics



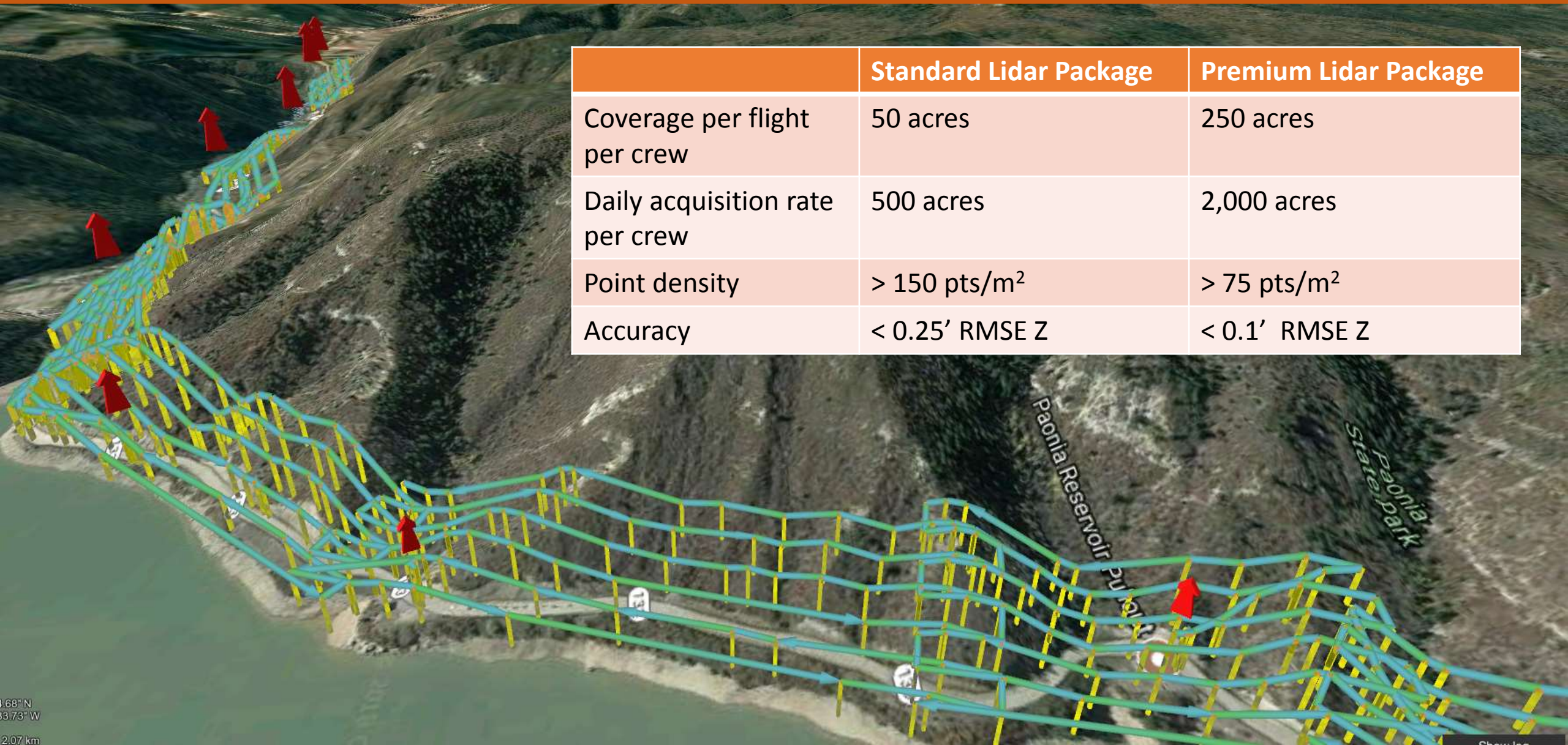
Juniper's Stable of Platforms/Sensors



Lidar Technology



Juniper Unmanned Lidar Capabilities



	Standard Lidar Package	Premium Lidar Package
Coverage per flight per crew	50 acres	250 acres
Daily acquisition rate per crew	500 acres	2,000 acres
Point density	> 150 pts/m ²	> 75 pts/m ²
Accuracy	< 0.25' RMSE Z	< 0.1' RMSE Z

Elevation Data Products

1) Colorized Lidar Point Cloud



2) Digital Terrain Model



2) Classified Point Cloud



3) Bare-Earth Contours



UAS Platform and LiDAR Limitations

- Wind < 25 mph
- Elevation < 12,000 ft
- Ground snow
- Very Dense vegetation
- Restricted airspace
- Rain/snow



Data Acquisition - Tuba City, AZ Disposal Site



Methods for Tuba City, AZ Disposal Site

- Acquisition – Dual sensor collection
 - Riegl miniVUX-1 LiDAR sensor
 - Dual Sony a6000 RGB sensors
- Processing
 - LiDAR
 - Raw LiDAR calibration
 - Colorize point cloud
 - Classified point cloud
 - Digital Surface Model (DSM)
 - Digital Terrain Model (DTM)
 - Contour creation
 - RGB image processing
 - Ortho Mosaic
 - Survey data post processing
 - RTX/OPUS post processing and calibration
- Analysis
 - Data accuracy assessment
 - Future Change Detection



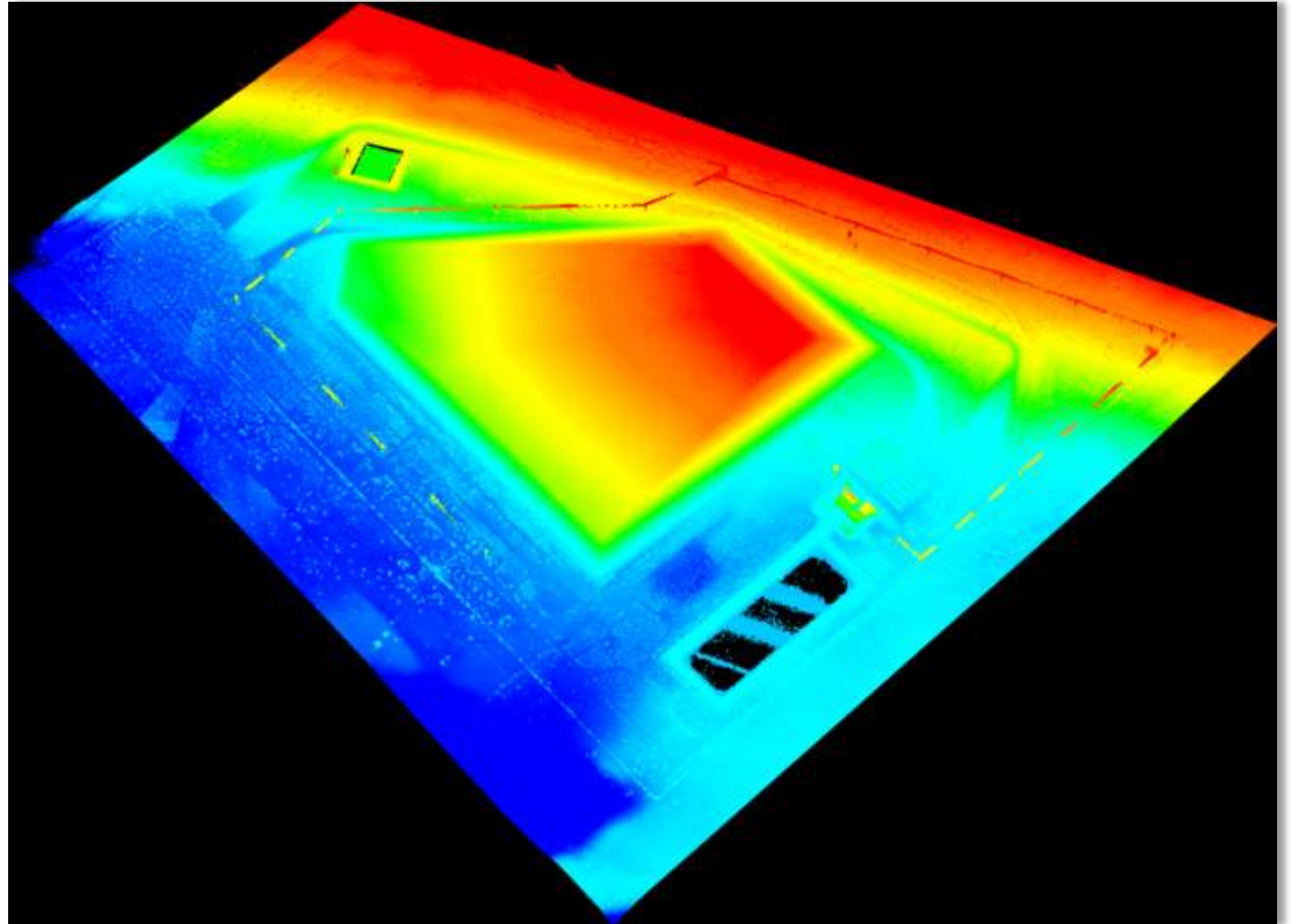
Data Acquisition Tuba City, AZ Disposal Site

- Collection in April 2018
- 505 acres site in Arizona
- 12 ground control points
- Platform: Altus ORC2 UAS
- Sensor: Riegl miniVUX-1
LiDAR sensor - dual collect w/
two Sony a6000 cameras



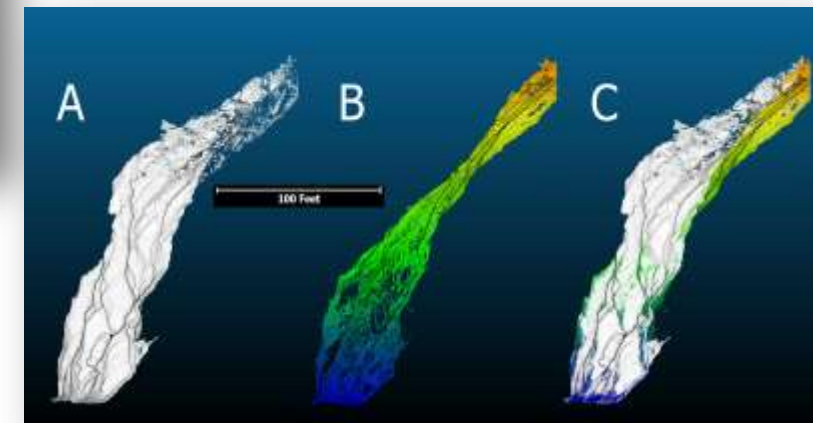
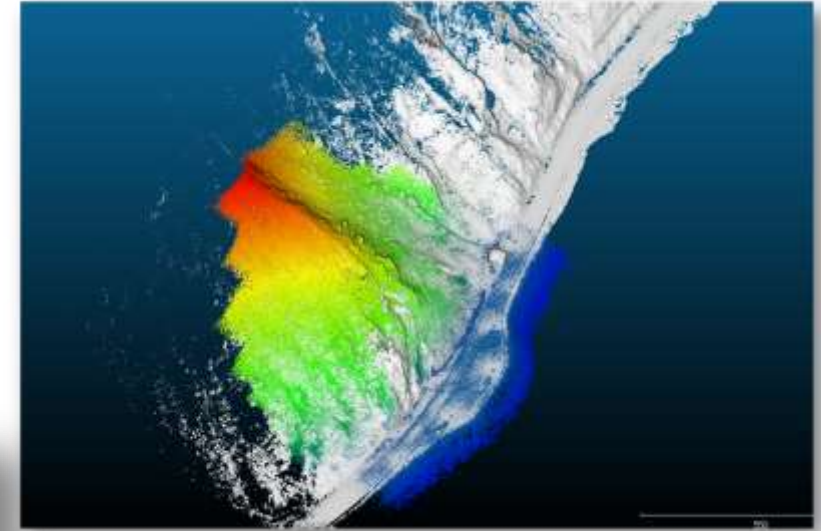
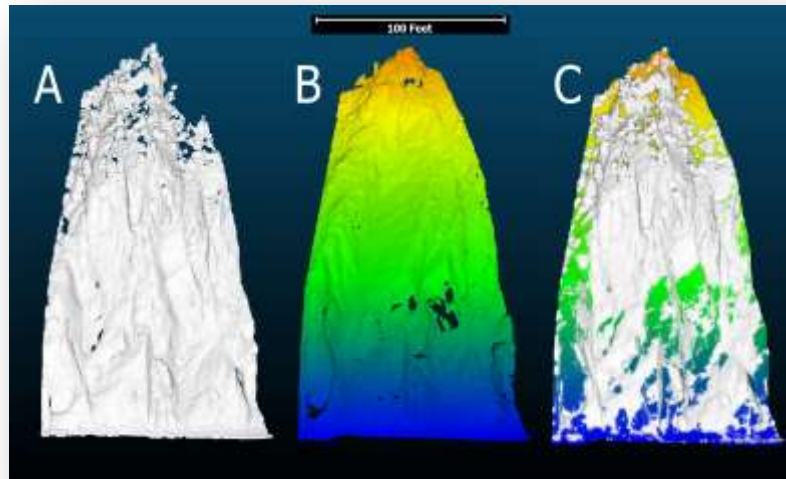
Accuracy Assessment Tuba City, AZ Disposal Site

- Riegl miniVUX-1
 - RMSEz = 0.073 US survey feet
 - Point density = approx. 75/m²



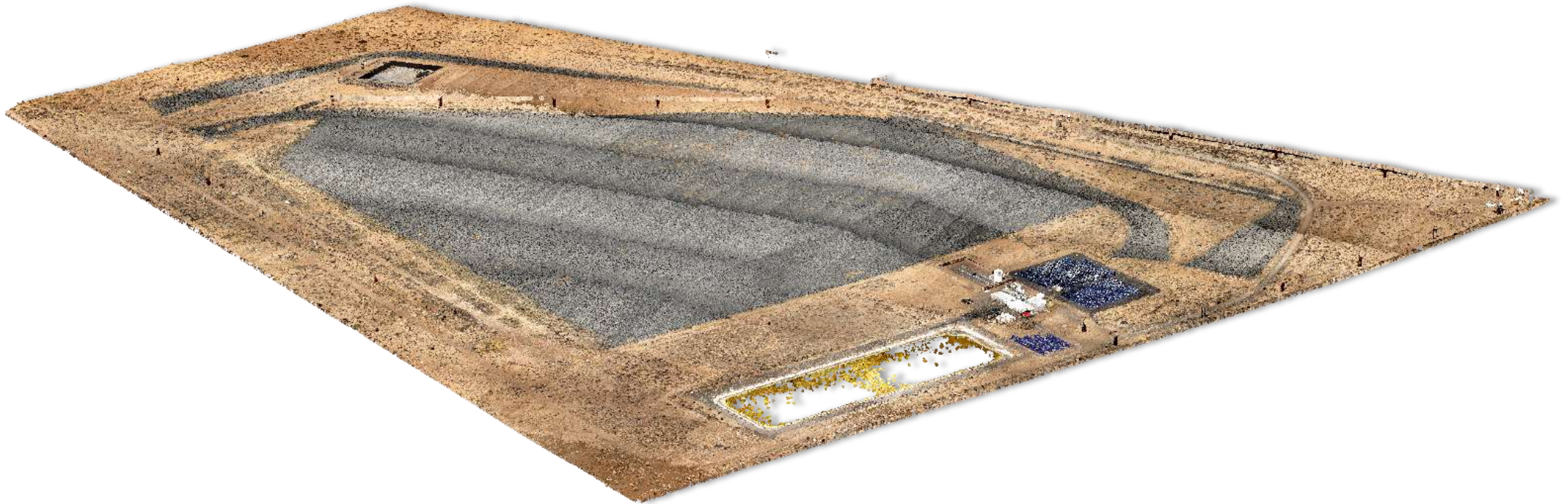
Change Detection

- Compare multiple surfaces and detect where change has happened and by how much
- Factors affecting change detection:
 - Point cloud density
 - Terrain
 - Vegetation
 - Point Classification
 - LiDAR Sensor Accuracy
 - Post-Processing



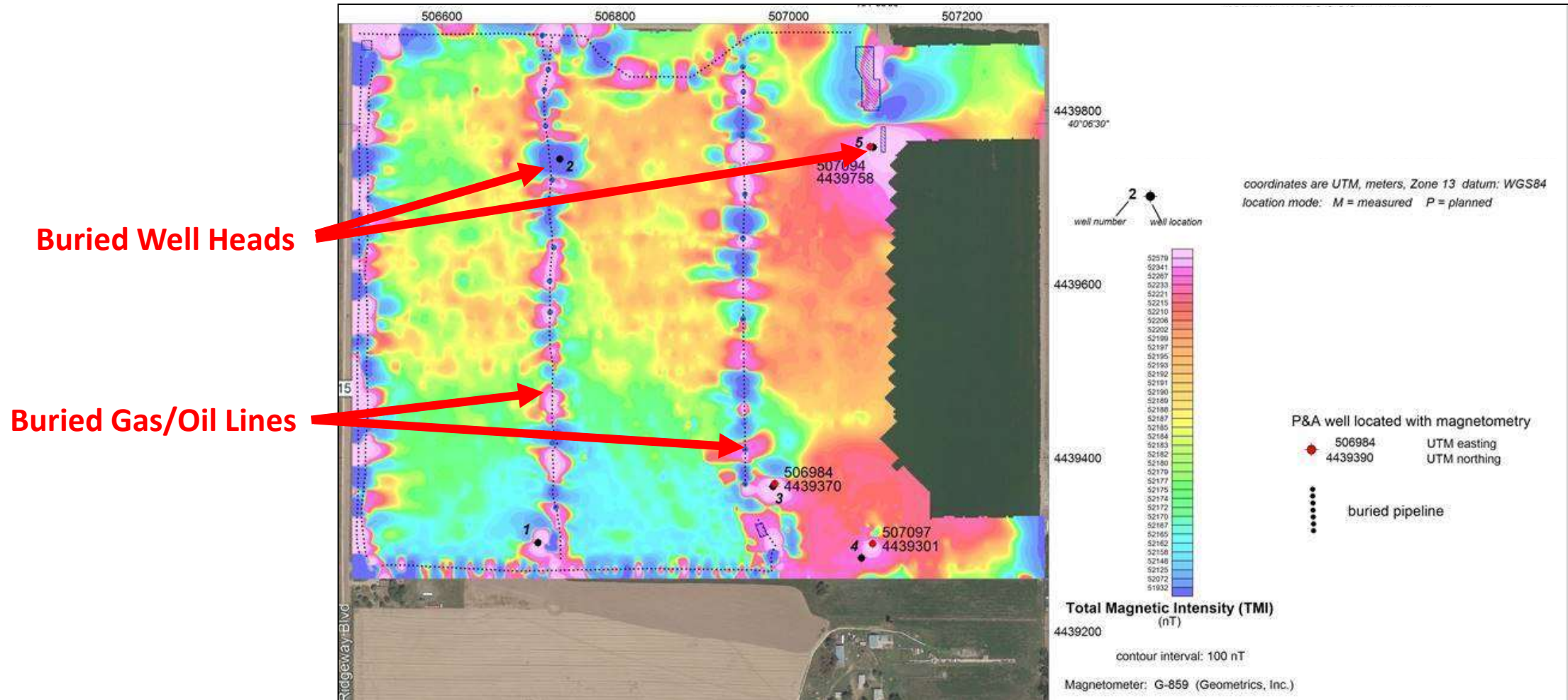
Benefits to Legacy Management

- Safety - Risk factors to personnel is reduced significantly
- Efficiency – 2000+ Acres per day of data collection
- Accuracy – better than 1/10th of a foot
- Density – Up to 250 points per meter squared



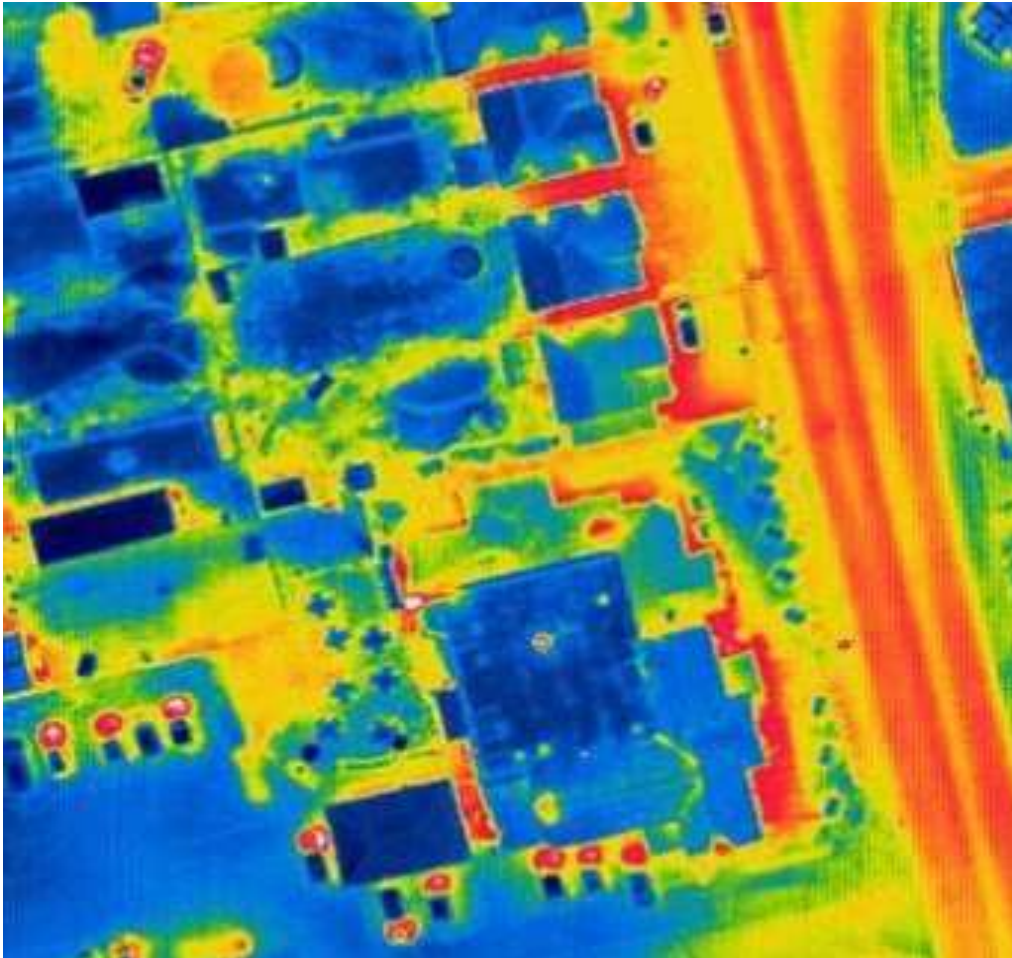
Other Potential Uses

Identification of buried objects and/or materials



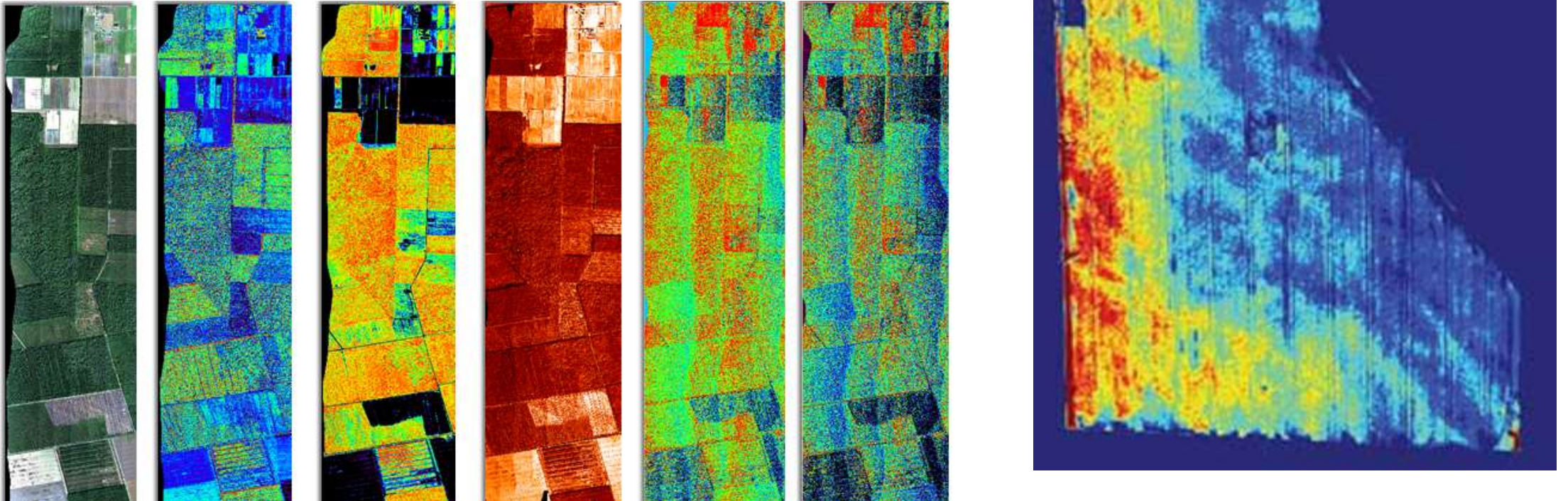
Other Potential Uses

- Identification of Hot Spots from abandoned/leaked materials



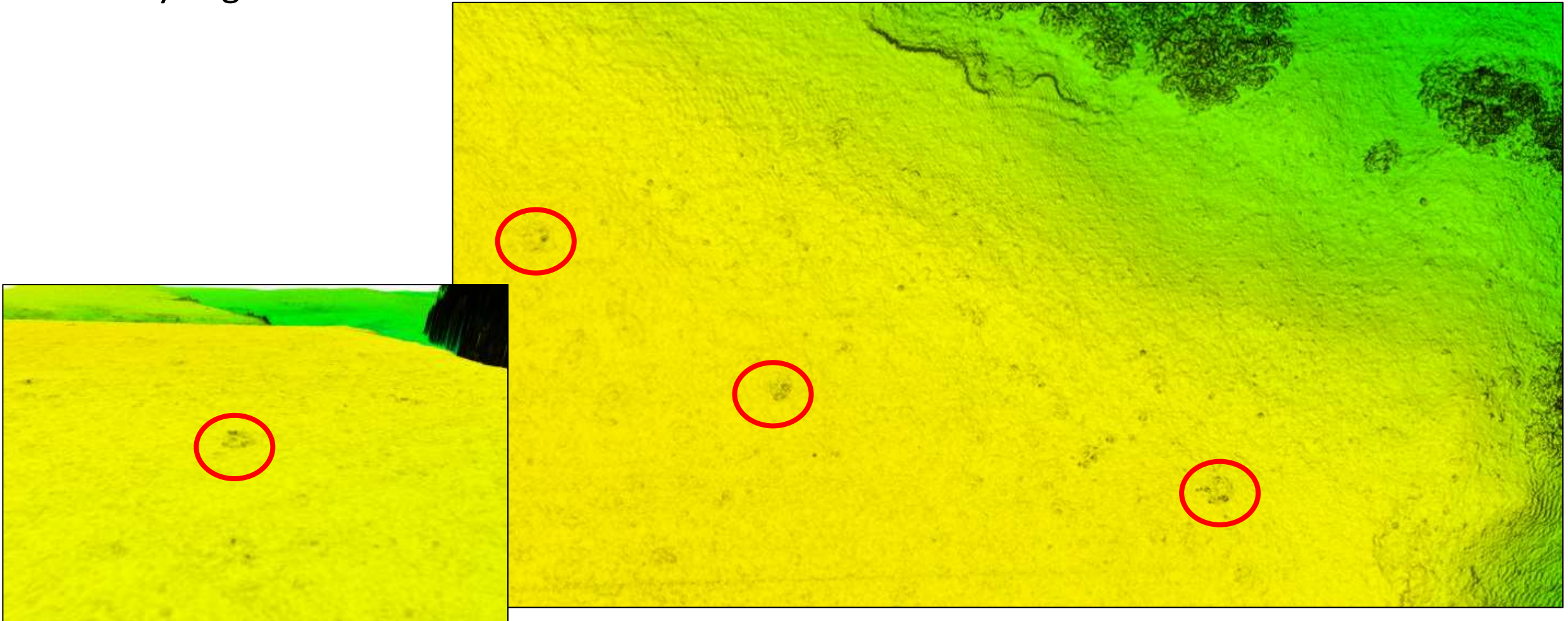
Other Potential Uses

- Identification of invasive vegetation species upon the property
- Stressed vegetation as an indicator of subsurface materials



Other Potential Uses

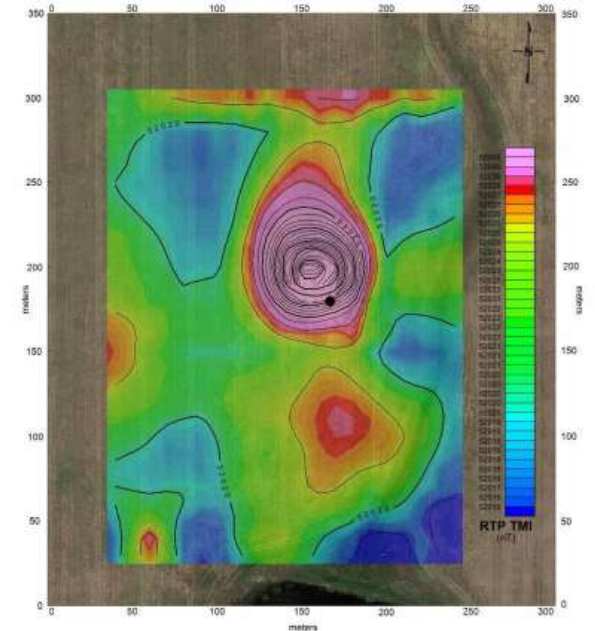
- Identification of unique natural, man-made or cultural features – Even those covered by vegetation



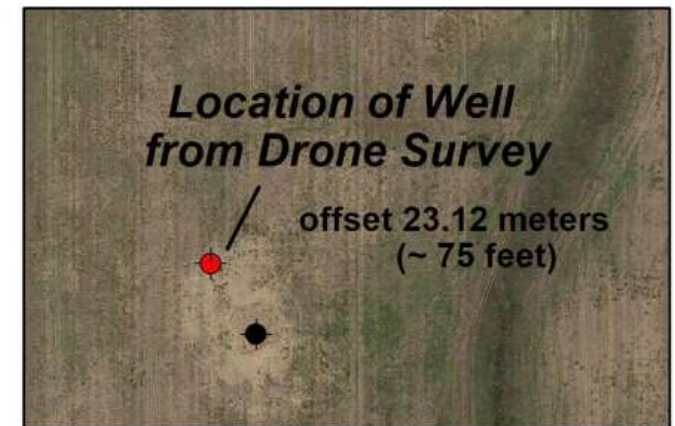
New Technology: UAS Magnetometry



"My impressions/view is the MagArrow was effective in finding large ferrous anomalies like historic gas/oil wells and could provide greater cost savings for customers when compared to traditional aerial magnetic surveys."



Color contour map of drone enabled magnetic survey data.



Other Sensors Available

- RGB Imagery
- 4K Video
- Thermal Imagery



Bathymetry coming in Q4 2018!

Thanks...

Questions?

